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Merrill

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[54] **LIFTING CLAMP CAM WEAR INDICATOR AND METHOD**

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[51] **Int. Cl.**[4] **B66C 1/48**; G01D 21/00

[52] **U.S. Cl.** **294/101**; 116/208; 294/902

[58] **Field of Search** 294/86.4, 101, 103.1, 294/104, 901, 902; 73/162; 116/208; 152/154.2; 269/285

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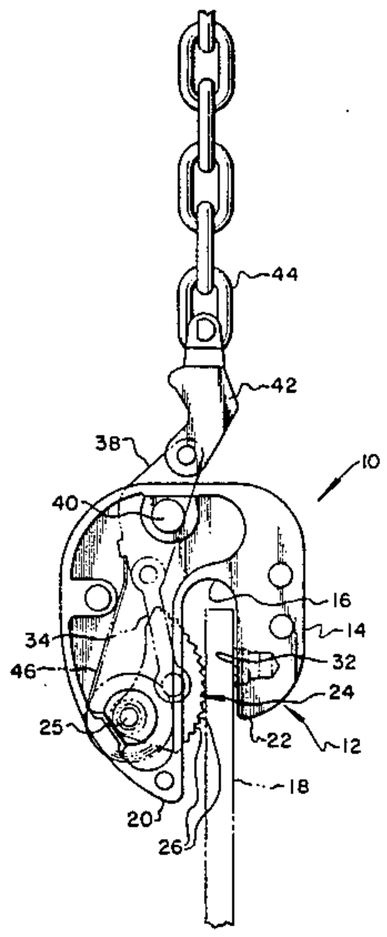
[57] **ABSTRACT**

A plate lifting clamp has an eccentric cam with spaced apart teeth having sharp crest edges which are provided with slots extending radially into the teeth. Excessive wear on the teeth may be visually observed by the decreasing depth of the slot or disappearance thereof on any one tooth. The tooth crests may be curved in a plane parallel to an axis of rotation of the cam so that a generally elliptical shaped surface appears on the tooth crest as it is worn away. The length of the wear surface may be measured to determine when cam replacement is desirable.

8 Claims, 7 Drawing Figures



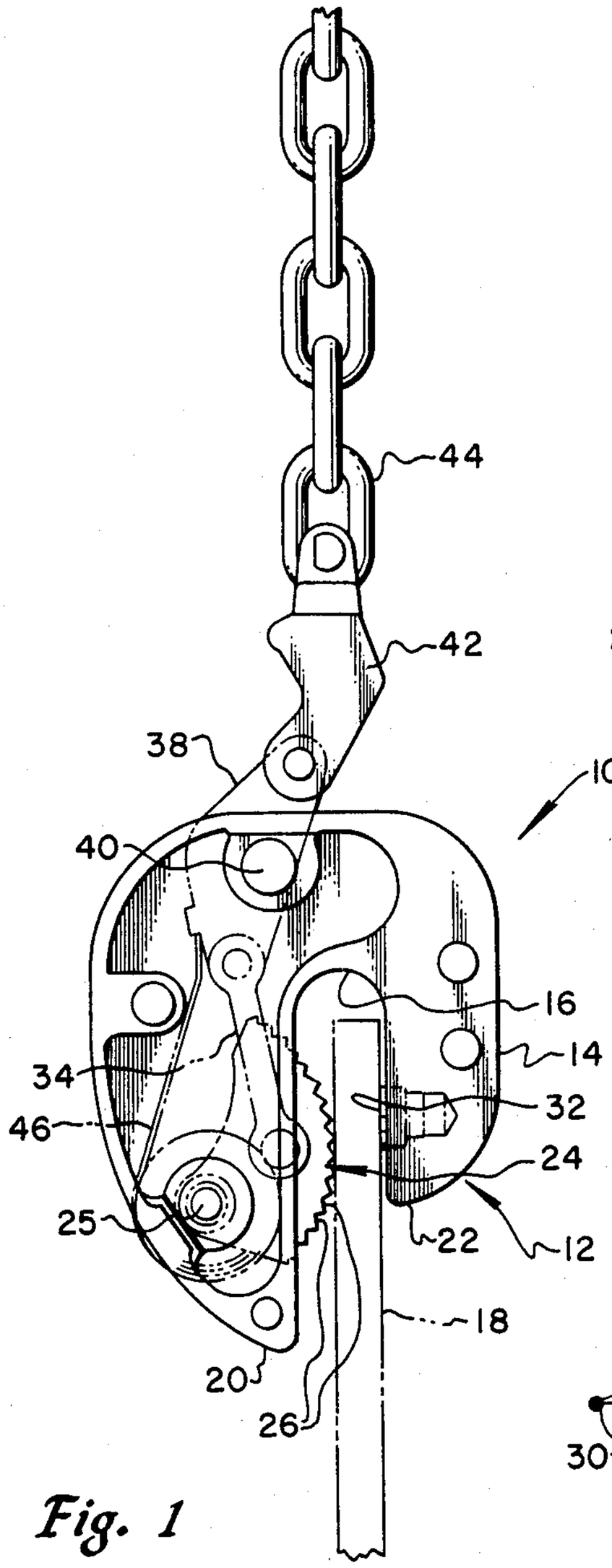


Fig. 1

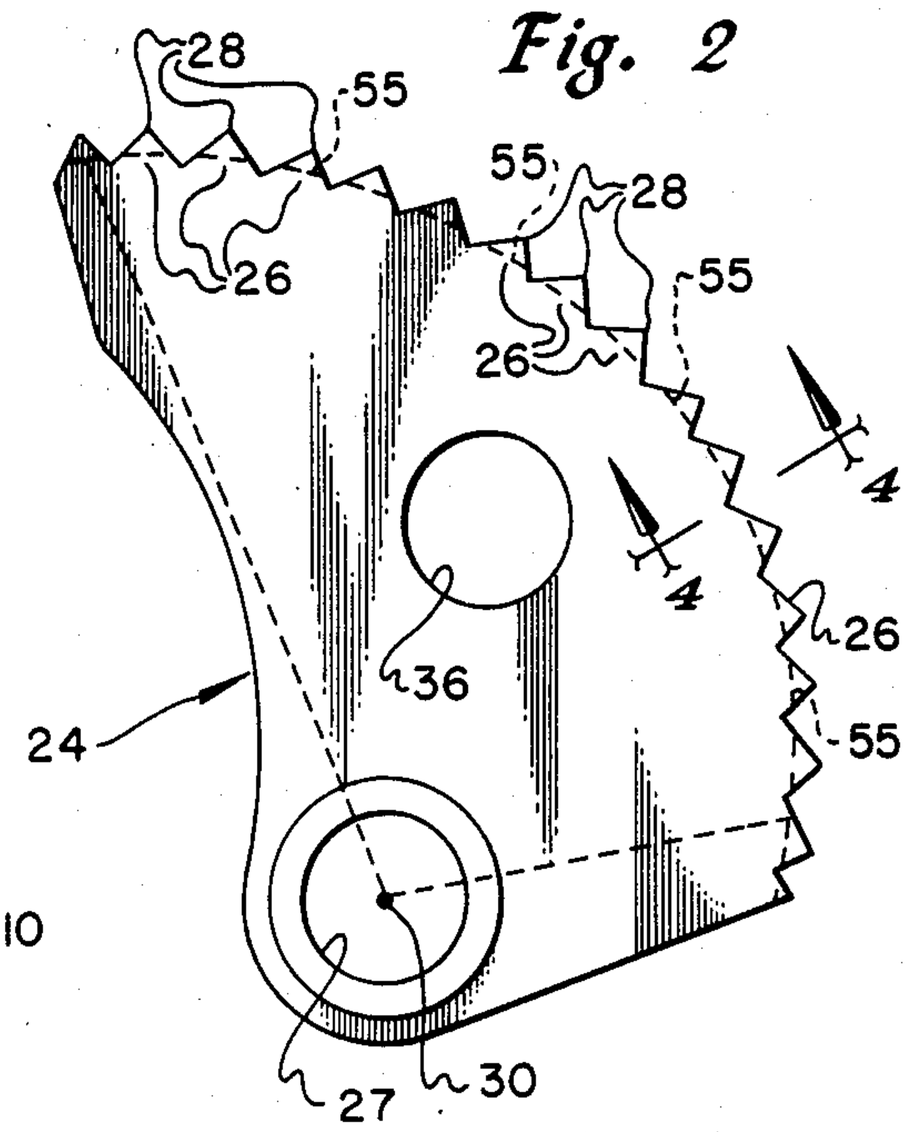


Fig. 2

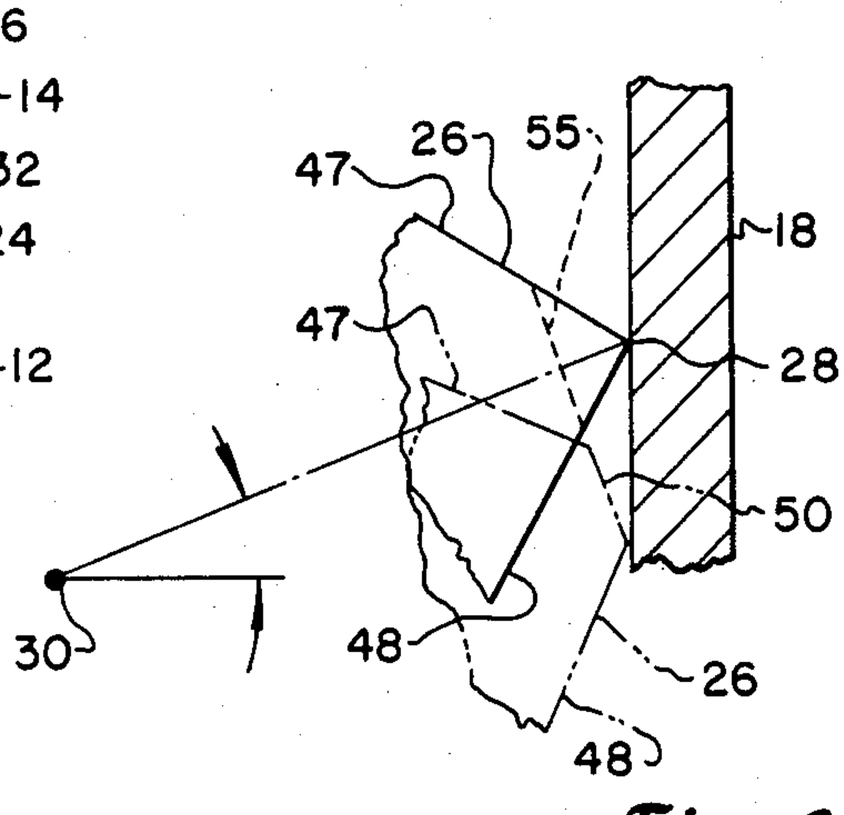


Fig. 3

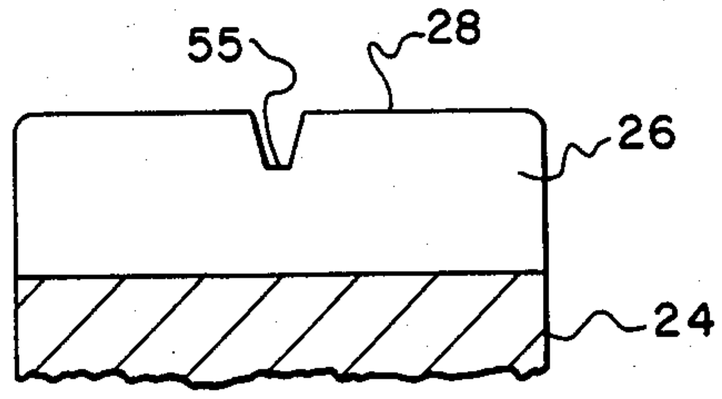


Fig. 4

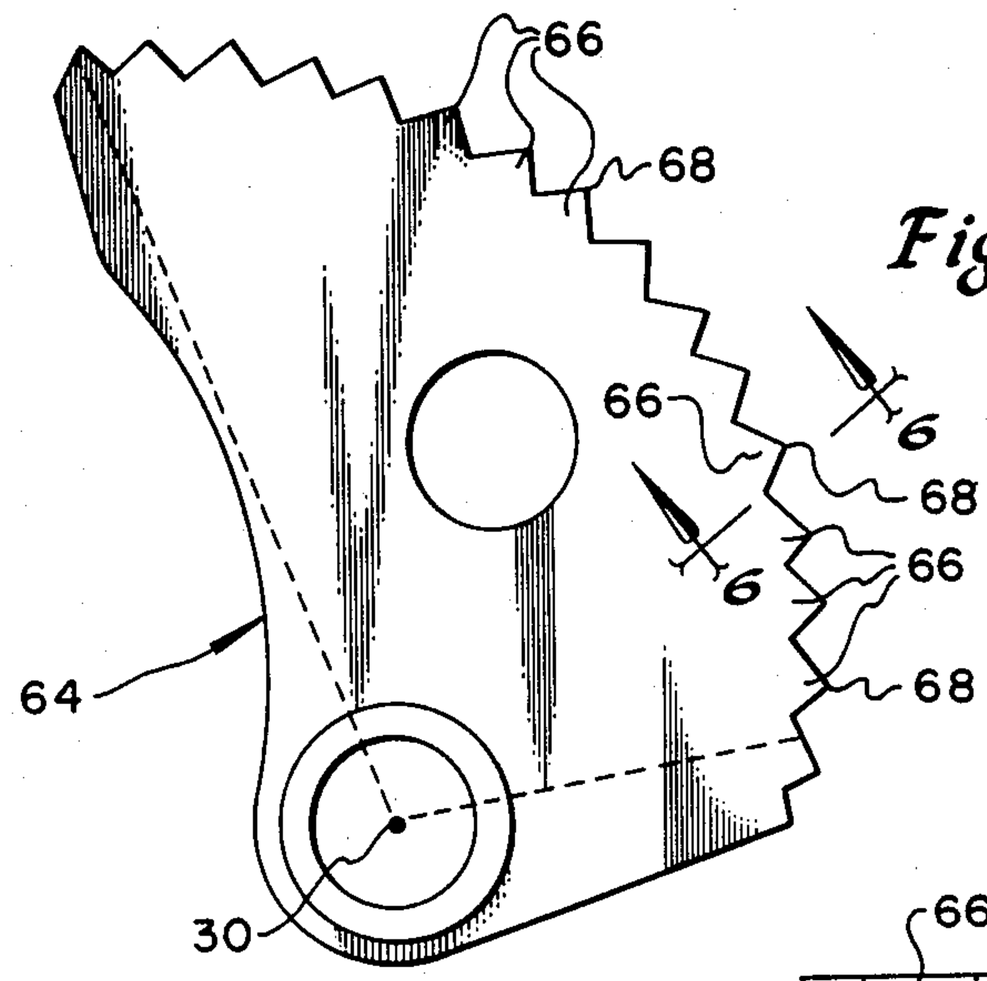


Fig. 5

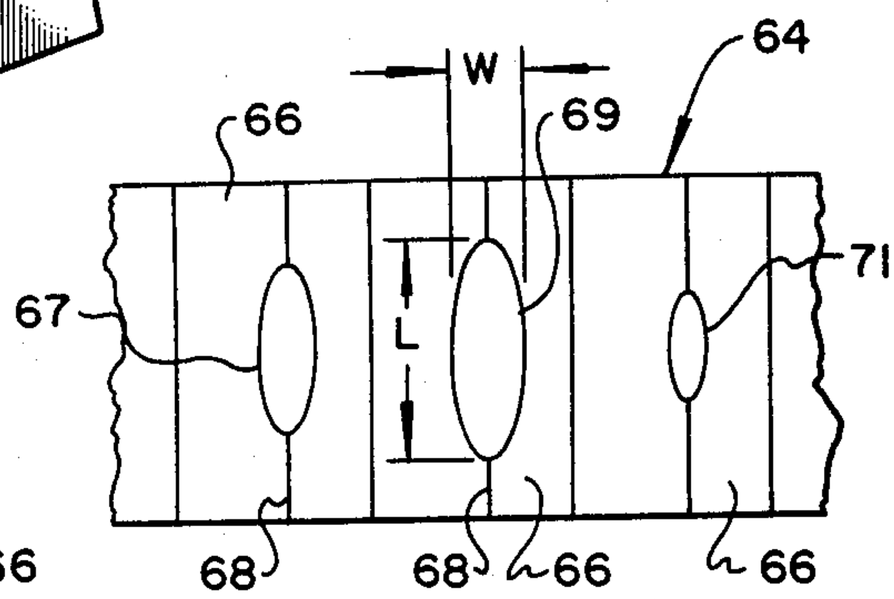


Fig. 7

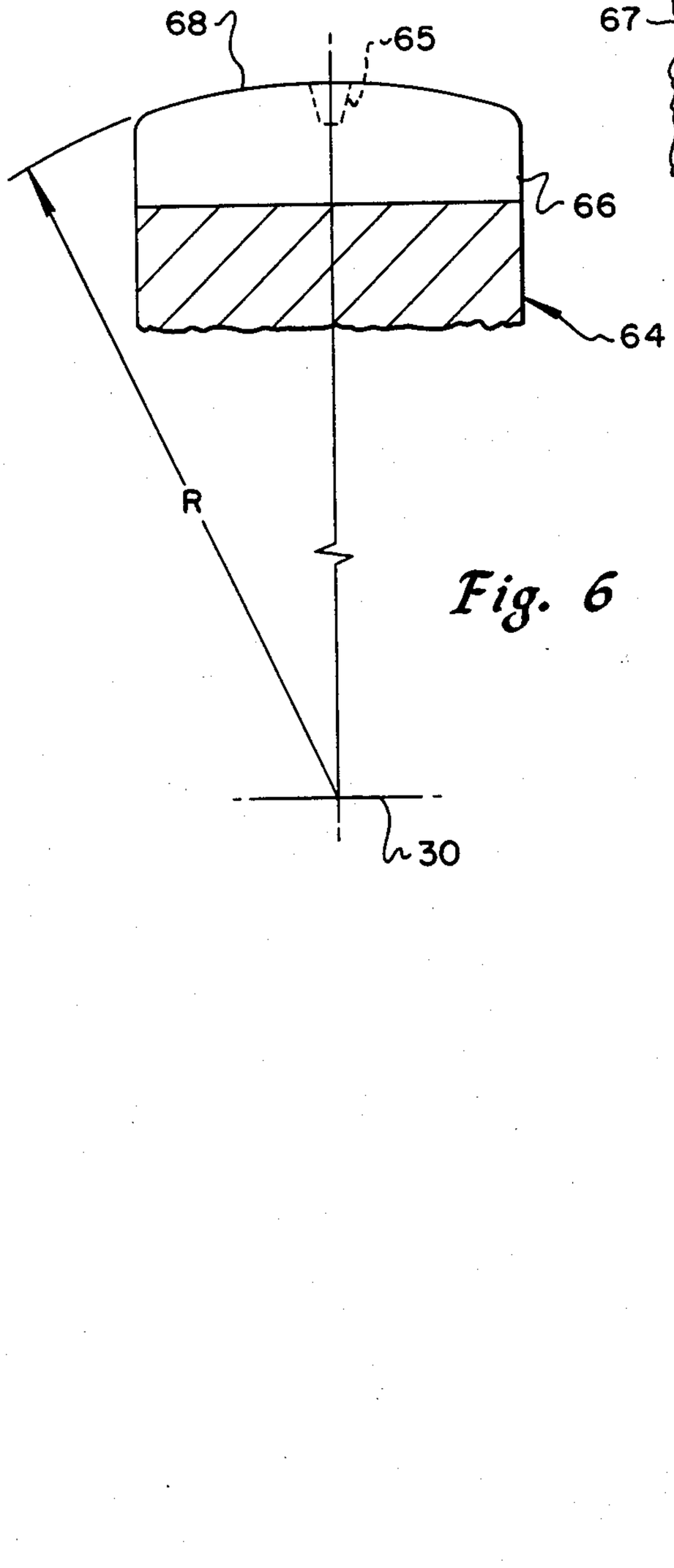


Fig. 6

LIFTING CLAMP CAM WEAR INDICATOR AND METHOD

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention pertains to a cam tooth wear indicator and method for lifting clamps used for lifting and conveying metal plate and other structural elements.

2. Background

Lifting clamps for heavy metal plate, various metal structural shapes and other elements such as materials storage drums are subject to relatively rough handling and rapid wear through use. These types of clamps are also typically used in rather harsh environments where abrasive material is often caught between the clamp cam surface and the elements being lifted which contributes to the rapid wear of the clamp cam.

The clamps are typically of a type wherein an eccentric cam is provided with a curved surface having a number of serrations or teeth which engage the element being lifted and are operable to increase their gripping force in direct proportion to the lifting or conveying effort exerted on the element being clamped. Since this type of clamp is typically used in applications wherein relatively unskilled workers are handling the clamp it is preferable that some relatively convenient form of wear indicator be provided for the cam teeth. Moreover, it is also desirable that a relatively convenient method of ascertaining the amount of tooth wear be available to the clamp operator so that the cams can be replaced when tooth wear approaches a point which would diminish the cam tooth penetration of the element being lifted and to some extent the lifting capability of the clamp.

One problem with lifting clamps of the type to which the present invention pertains relates to the relative difficulty with which the clamp cam can be visually inspected or measured. Typically, the type of clamp with which the present invention is used includes a somewhat inverted "u" shaped jaw on which an eccentric cam is supported for pivotal movement and connected to suitable linkage for urging the cam into gripping engagement with the plate or structural member to be lifted by the clamp. The clamp cam is usually disposed in the recess formed by the jaw and is not easily accessible for inspection or measurement. Accordingly, a convenient visual inspection method and means is highly desirable to indicate the condition of the cam teeth during use of the clamp and without requiring that the clamp be disassembled or removed from its normal work site.

SUMMARY OF THE INVENTION

The present invention provides an improved material handling apparatus, specifically a plate or structural element lifting clamp having an eccentric toothed gripping cam which is provided with improved means for visually detecting cam tooth wear. The present invention also provides a unique method of determining cam tooth wear for a material handling lifting clamp or the like.

In accordance with one aspect of the present invention there is provided a material lifting clamp having an eccentric cam with a plurality of spaced apart gripping teeth for engagement with a metal plate or other structural elements for use in lifting and handling such material and wherein the teeth are each provided with a generally centrally located slot extending normal to the tooth crown. The slots are of a prescribed depth so that as a tooth wears down toward its root or base the depth of the slot will diminish and the slot in fact will disappear when wear is sufficient to recommend replacement of the cam. In accordance with another aspect of the present invention there is provided a material lifting clamp having an improved cam tooth configuration which will develop a predetermined wear pattern, which wear pattern may be conveniently measured to determine when the cam teeth have worn to a degree recommending cam replacement.

The present invention still further provides an improved material handling or lifting clamp generally of the type having a pivoting cam which is self-gripping as lifting forces are applied to the clamp and the material gripped thereby. Those skilled in the art will recognize the above noted features and advantages of the present invention as well as other superior aspects thereof upon reading the detailed description which follows in conjunction with the drawing.

BRIEF DESCRIPTION OF THE DRAWING

FIG. **1** is a side elevation of an improved material handling or lifting clamp for metal plate and other structural shapes in accordance with the present invention;

FIG. **2** is a detail side elevation of an improved cam for the lifting clamp of the present invention;

FIG. **3** is a detail view showing the preferred position of a tooth when gripping or clamping a metal plate in the unworn position versus a somewhat worn condition of the tooth crest;

FIG. **4** is a detail section view taken along the Line **4—4** of FIG. **2**;

FIG. **5** is a detail side elevation of a cam in accordance with an alternate embodiment of the present invention;

FIG. **6** is a detail section view taken along the line **6—6** of FIG. **5**; and

FIG. **7** is a developed plan view of some of the teeth of the cam illustrated in FIGS. **5** and **6** showing a measurable wear pattern developing on certain teeth.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

In the description which follows like parts are maked throughout the specification and drawing with the same reference numerals, respectively. The drawing figures are not necessarily to scale and certain features of the invention may be shown exaggerated in scale in the interest of clarity.

Referring to FIG. **1**, there is illustrated a material handling device in the form of a metal plate or other structural member lifting clamp, generally designated by the numeral **10**. The lifting clamp **10** is of a type which is typically used in metal plate fabricating and warehousing installations for lifting steel, aluminum and other types of metal plate of relatively heavy weights, for example, from 0.50 tons up to approximately 7.0 tons or more. The lifting clamp **10** is characterized by a generally inverted "u" shaped housing **12** formed by a pair of spaced apart jaw members **14**, one shown, which are aligned with each other and form a somewhat inverted "u" shaped opening **16** for receiving a metal plate **18** or other portion of a structural member. The

lifting clamp **10** may be of a type known as a series "G" lifting clamp made and sold under the trademark Merrill by the Campbell Chain Division, Cooper Industries, Inc., York, Pa. The lifting clamp **10** may be used singly or in pairs and suspended from a lifting sling for lifting the metal plate **18** or other structural members. The clamp **10** is typically used in a relatively harsh working environment wherein repeated use of the clamp causes relatively rapid wear of the working parts and in particular the plate gripping cam which will be described in further detail herein.

Preferably, the housing **12** is constructed such that the jaws **14** have opposed depending leg portions **20** and **22** wherein the leg portion **20** is of a greater length or extent as compared with the leg portion **22**. The lifting clamp **10** is of a type having a movable cam, generally designated by the numeral **24**, which is mounted between the jaw members **14** and is pivotable about a pivot pin **25** between working and nonworking positions. The cam **24** is of a configuration, see FIG. **2** also, which approximates a circular sector and is provided with a plurality of spaced apart parallel teeth **26** having, respectively, transversely extending sharp crests **28**. A pivot pin bore **27** is provided for receiving the pin **25** and which is eccentric with respect to the radius center of an arcuate rim formed by the teeth **26**. The teeth **26** are arranged relative to a pivot axis **30** of the cam **24** such that successive ones of the teeth make a preferred gripping angle in engagement with a metal plate over a range of plate widths which are predetermined by selection of the width of the opening **16** and hence the grip range size of the clamp **10**.

The cam **24** is somewhat-self energizing in gripping the plate **18** between a serrated pad **32**, FIG. **1**, and the cam teeth **26**. A connecting link **34**, FIG. **1**, is pivotally connected to the cam **24** at a pivot bore **36**, see FIG. **2**, spaced from the pivot axis **30**. The link **34** is connected to a radius link **38** which is also mounted on the housing **12** between the jaws **14** for pivotal movement about a pivot **40**. The link **38** is further pivotally connected to a lifting member **42** which, in turn, is connected to a lifting chain **44** or other lifting means, not shown. The links **34**, **38** and the member **42** are operable to effect movement of the cam **24** into a plate gripping position and wherein, in response to exerting a lifting force on the member **42**, the cam **24** is biased into ever tighter gripping engagement with the plate **18** as a lifting force is exerted on the clamp **10** to lift the plate. The lifting clamp **10** may also be provided with a torsion coil spring, generally designated by the numeral **46**, which is disposed around a hub portion of the cam **24** and is operable to bias the cam into the plate gripping position, at all times. Those skilled in the art will appreciate that the position of the cam **24**, as urged by the spring **46**, to close over the opening **16** further aggravtes the relatively rapid wear which is experienced on the gripping teeth **26** whereby, in any usage of the clamp **10**, the cam is engaged by the plate or other member to be gripped by the clamp as the member is inserted into the opening **16**. This type of action can result in high impact as well as rapid wear type forces being exerted or imparted to the cam **24** during normal use.

The geometry of the spaced apart teeth **26** as regards the pivot axis **30** is of some importance to achieving a suitable gripping engagement of a plate such as the plate **18**. As illustrated in FIG. **3**, preferably, each of the teeth **26** is adapted to have opposed planar flanks **47** and **48** which intersect each other to form the crest **28**. The crest **28**, forming a somewhat sharp edge and typically being of heat treated and hardened steel, forcibly engages and penetrates the surface of the plate **18** during gripping thereof. The crest **28** is, however, subject to rapid wear, depending on the operating environment and care with which the clamp **10** is utilized, and forms a somewhat flattened surface **50** after a certain amount of wear takes place. The formation of the flattened surface **50** may actually be somewhat more irregular than illustrated in FIG. **3** and the intersections of the flanks **47** and **48** with the surface **50** may be somewhat rounded in shape as opposed to the relatively sharp edges illustrated in the drawing figure. In any case, as the sharp crest edge **28** wears away a relatively flat surface such as the surface **50** is formed.

In this regard it is desirable to avoid the detriments of excessive wear of the cam gripping teeth **26** by preferably providing each of the teeth with a wear indicator slot **55**, as illustrated in FIGS. **2**, **3** and **4**. The slot **55** is preferably placed about midway along the crest **28** between opposite lateral sides of the teeth **26** and extends normal to the crest into a tooth **26** to a depth which is predetermined to correspond to the maximum allowable wear of a tooth before the cam **24** should be replaced. The slots **55** are easily viewable when the cam **24** is in use or when the clamp **10** has released its engagement with a plate or other structural member since, as indicated by a working position of the cam **24** in FIG. **1**, a substantial number of working teeth may be easily viewed as the cam pivots into a nonworking position when a plate or other member is removed from the opening **16**. Accordingly, visual inspection is easily obtained even if only one tooth **26** is excessively worn due to repeated use of the clamp **10** with plates of eaual width. If, upon even casual visual inspection, it is observed that one or more of the slots **55** have "disappeared" from one or more of the teeth **26** it is indicated that the cam **24** should be replaced in order to minimize the chance of malfunction of the clamp **10**.

Referring now to FIGS. **5**, **6** and **7** an alternate embodiment of the present invention is provided in the form of a cam **64** similar to the cam **24** and provided with a plurality of spaced apart wedge shaped teeth **66** having sharp edged crest portions **68**. The cam **64** is adapted to be mounted in a housing **12** and otherwise provide a plate clamp virtually identical to the plate clamp **10**. Each of the working teeth **66** of the cam **64** has a somewhat arcuate or otherwise crowned crest **68** of radius R, as indicated in FIG. **6**, when viewed in a plane parallel to the pivot axis **30**. Although the teeth **66** may be provided with a wear indicator groove or slot, **65**, similar to the slots **55** provided for the flat surfaced teeth **26**, the cam **64** is preferably provided without the wear indicator slots.

Thanks to the curvature of the crests **68**, as illustrated in FIG. **6**, progressive wear on the teeth **66** will generate somewhat oval or elliptical shaped surfaces, as illustrated in FIG. **7**, and designated by the numerals **67**, **69** and **71** for respective adjacent ones of the teeth **66**. When the extent of one of the somewhat oval wear surfaces **67**, **69** and **71** reach a predetermined length "L" and/or width "W", FIG. **7**, it is indicated that the cam **64** should be replaced in order to minimize problems with proper functioning of a plate clamp utilizing a cam **64** in place of a cam **24**, for example. Again, due to the relatively easy manner in which the cams **24** or **64** may be viewed, particularly when they are placed in a nonworking position when the clamp is empty, the amount

of wear incurred by one or more of the teeth **64** may be conveniently measured by a machinist's scale or other suitable measuring device provided for the purpose of determining the length or width of the surfaces **67**, **69** and **71**. Accordingly, if any of the teeth **66** have the relatively large wear surface **69** compared with predetermined limit values for such measurements, it is indicated that the cam **64** should be replaced by a new cam. The provision of a curved crest edge **68** for each of the working teeth **66** provides for the unique configuration and easily recognizable shape of the wear surface which will alert the user of the plate clamp utilizing the cam **64** that the cam should be replaced.

Accordingly, in regard to the second embodiment of the present invention there is contemplated a method for determining the amount of wear on the plate gripping cam of a material handling lifting clamp wherein the cam is provided with a plurality of spaced apart gripping teeth which are arranged on an arcuate rim or surface, which teeth include a somewhat curved crest edge as viewed in a plane generally parallel to the axis of rotation of the cam. If, upon being subjected to wear from repeated use of the cam **64**, a generally flat somewhat oblong or elliptical shaped surface develops, the length and/or width of the surface is measured. At a predetermined length or width, indicating a predetermined amount of wear, the cam is replaced.

Although preferred embodiments of the present invention have been described herein those skilled in the art will recognize that various substitutions and modifications may be made to the specific tooth configuration and method of determining excessive wear in a material handling and lifting clamp of the type described without departing from the scope and spirit of the invention as recited in the appended claims.

What I claim is:

1. In a lifting clamp for lifting metal plate or the like, a clamp housing including means forming a "u" shaped recess for receiving a portion of the metal plate or the like, a plate gripping cam pivotally mounted on said clamp housing for movement into gripping engagement with the metal plate or the like for securing the metal plate or the like to said clamp housing between said plate gripping cam and one side of said "u" shaped recess, said plate gripping cam including a plurality of spaced apart plate gripping teeth arranged along an arcuate rim with respect to an axis of rotation of said plate gripping cam, said spaced apart plate gripping teeth including a crested edge extending generally in a plane parallel to said axis of rotation of said plate gripping cam and at least one of said crested spaced apart plate gripping teeth having a slot in said crested edge which may be viewed from the exterior of the lifting clamp when a plate member is not disposed in said "u" shaped recess, said slot providing a means for indicating wear, whereby when said tooth having a crested edge in a slot is used to a degree such that said crested edge is worn away, the depth of said slot in said crested edge tooth will be reduced or will disappear thereby indicating to the observer the degree of wear on said crested edge tooth.

2. The lifting clamp as defined in claim **1**, wherein:

said slot in said crested edge is located approximately midway between opposite lateral sides of said crested edge spaced apart plate gripping teeth.

3. The lifting clamp as defined in claim **1** wherein:

said crested teeth have a rounded crown crest edge generally in a plane parallel to said axis of rotation of said cam.

4. In a lifting clamp for lifting a metal plate or the like, a clamp housing including means forming a "u" shaped recess for receiving a portion of the metal plate or the like, a plate gripping cam pivotally mounted on said clamp housing for movement into gripping engagement with the metal plate or the like for securing the metal plate or the like to one side of said "u" shaped recess in said clamp housing, said plate gripping cam including a plurality of spaced apart plate gripping teeth arranged along an arcuate rim with respect to an axis of rotation of said plate gripping cam, at least one of said plate gripping teeth having a crest extending generally in a plane parallel to said axis of rotation of said plate gripping cam, each of said crested plate griping teeth having a slot in said crest located approximately midway between opposite lateral sides of said plate gripping cam which slot may be viewed from the exterior of said lifting clamp, whereby said slot will provide means for indicating wear when said crested tooth is worn to a degree such that said crest is diminished said slot in said crested tooth will disappear thereby indicating excessive wear on said crested tooth.

5. A method for determining excessive wear on a cam for a lifting clamp comprising the steps of:

providing a plate lifting clamp including a clamp housing including means forming a recess for receiving a portion of a metal plate member or the like, a plate gripping cam pivotally mounted on said housing for movement into gripping engagement with said plate member for securing said plate member to said housing, said cam including a plurality of spaced apart plate gripping teeth arranged along a rim with respect to an axis of rotation of said cam, at least selected ones of said teeth including a crest edge extending generally in a plane parallel to said axis of rotation and having a curvature when viewed in said plane whereby as said teeth wear away toward said axis a generally planar oval surface develops;

inspecting said teeth from time to time to determine the existence of said oval surface; and

measuring said oval surface to determine the extent of wear on said teeth, respectively.

6. The method set forth in claim **5**, including the step of:

measuring the length of said oval surface parallel to said crest edge.

7. The method set forth in claim **5**, including the step of:

measuring the maximum length and width of said oval surface and comparing said measurements with predetermined limit measurements to determine the extent of wear on said teeth.

8. A wear indicating system for a device for lifting a metal plate or the like comprising:

a lifting clamp, said lifting clamp including a housing forming a U-shaped recess for receiving a portion of the metal plate or the like;

a plate gripping cam pivotally mounted on said housing for movement into gripping engagement with the plate member or the like for securing the plate member or the like to said housing, said plate gripping cam including an arcuate rim with respect to an axis of rotation of said plate gripping cam;

a plurality of spaced apart plate gripping teeth arranged along said arcuate rim;

at least one of said spaced apart plate gripping teeth including a curved crest constructed and arranged to form a substantially oval surface as said tooth wears whose area is indicative of the wear of said tooth; and

means integral with said curved crest spaced apart plate gripping teeth to determine the size of said substantially oval surface.

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